CLINICAL RESEARCH STUDIES

From the Society for Clinical Vascular Surgery

Endovascular treatment of stenotic and occluded visceral arteries for chronic mesenteric ischemia

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Purpose: **Percutaneous angioplasty and stenting (PTAS) is emerging as a therapeutic option for patients with chronic mesenteric ischemia. This study evaluated patency and mortality, and their relationship between degree of vessel occlusion (stenotic or totally occluded), stent characteristics, and comorbidities in patients who were treated with PTAS of the visceral vessels for chronic mesenteric ischemia.**

Methods: **A retrospective review was performed of the records of all patients who underwent PTAS of the celiac, superior mesenteric, or inferior mesenteric arteries, or both, for symptomatic chronic mesenteric ischemia between January 2001 and December 2005. Patient demographics, lesion characteristics (stenosis or occlusion), interventional details, and early and late mortality rates were recorded. Cumulative mortality and patency rates and factors associated with outcomes were determined using Kaplan-Meier method and Cox proportional hazards modeling.**

Results: **Eighty-seven mesenteric vessels (57 superior mesenteric, 23 celiac, and 7 inferior mesenteric arteries) were treated in 65 patients (29 men and 36 women). Completely occluded vessels were treated in 18 patients (28%), and >60% stenosis was treated in 47 patients (72%). Mesenteric angina was the most common symptom (97%). For the entire series, the cumulative 1-year results were primary patency, 65% (95% confidence interval [CI], 50%-80%); primary assisted patency, 97% (95% CI, 92%-100%); secondary patency, 99% (95% CI, 96%-100%); and survival, 89% (95% CI, 80%-98%). All deaths occurred ≤60 days after treatment. The endovascular treatment of visceral artery occlusion was not associated with diminished patency or survival, irrespective of stent size or number. Patients requiring bowel resection were less likely to survive than those who did not (odds ratio [OR], 26; 95% CI, 3.5-192; $P < .001$). One-year primary patency was worse among patients with chronic obstructive pulmonary disease (OR, 3.2; 95% CI, 1.4-7.7; $P = .009$) or who had femoral access (OR, 3.0; 95% CI, 1.1-7.9; $P = .015$).**

Conclusions: **For patients with chronic mesenteric ischemia, the results of endovascular treatment of occluded mesenteric arteries are indistinguishable from those treated for stenotic vessels. Patients requiring bowel resection are less likely to survive, and those with chronic obstructive pulmonary disease or who had femoral access have higher reintervention rates. (J Vasc Surg 2008;47:485-91.)**

Percutaneous transluminal angioplasty and stenting (PTAS) of the visceral arteries is an evolving and viable alternative for treatment of chronic mesenteric ischemia (CMI).[1,2] Although subintimal angioplasty or recanalization of totally occluded vessels is a well-know technique for treating totally occluded coronary arteries,[3] iliac arteries,[4] and lower extremity vessels,[5] this technique is not frequently used in those patients with chronically occluded visceral arteries. Resch et al[6] previously described a small series of patients who had completely occluded visceral vessels revascularized by PTAS. There are several perceptions about why endoluminal revascularization of totally occluded visceral vessels is sometimes avoided, including increased technical difficulty, higher incidence of restenosis due to increased plaque burden, and potentially increased complications such as embolization or dissection. In addition, open surgical revascularization allows one to visualize and inspect the intra-abdominal organs and intestines for the sequelae of embolization.

Although previous series have compared open surgical revascularization and PTAS of visceral arteries for occlusive disease,[7,8] the specific factors that may be responsible for restenosis, morbidity, mortality, and loss of patency in those patients who have undergone PTAS of the visceral arteries have not yet been evaluated. In addition to total

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Competition of interest: Dr Clair is a consultant for Cordis, is on the Speakers Bureau of FoxHollow and Cook, and is on the Advisory Board of Medtronic and Boston Scientific. Dr Lyden is on the Speakers Bureau and is a consultant for Boston Scientific. Dr Sarac is founder, consultant, and stockholder of PeriTec Biosciences and is on the advisory board of Medtronic.

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occlusion and patient demographics, the association between patency and stent type, diameter, and number of vessels treated for CMI has not been previously evaluated to our knowledge. In this study, we evaluate patency and mortality, and their relationship between degree of vessel occlusion (partially or totally occluded), stent characteristics, and comorbidities in patients who were treated with PTAS and stenting of the visceral vessels for CMI.

METHODS

Patients. All patients who underwent PTAS for CMI between January 2001 and December 2005 by members of our department were prospectively entered into a computerized database. We performed a retrospective review of hospital records of consecutive patients with CMI who underwent PTAS. Patients with aortic dissections, concomitant aneurysm repair, nonocclusive mesenteric ischemia, previous mesenteric PTA or stenting, or both, and acute mesenteric ischemia were excluded from analysis. Records were reviewed for patient demographics, preoperative and postoperative symptoms, and duplex ultrasound (DUS) findings. Operative notes and angiograms were reviewed for each vessel treated, degree of stenosis or total occlusion, and stent type and size. This study had approval of our Institutional Review Board.

Demographics. Patient demographics and symptoms are listed in Table I (online only). Most patients presented with intestinal angina (95.4%), but 67.7% also had weight loss, and 26.4% had bowel dysfunction (diarrhea or constipation). Eighty-seven blood vessels were treated in 65 patients.

Procedural details. Preoperative evaluation included physical examination, DUS imaging or computed tomography scan, or both, followed by arteriography. The DUS criteria for stenosis and restenosis were adapted from criteria previously described by Moneta et al[9] and Zwolak et al.[10] Stenosis >60% was considered hemodynamically significant for therapy and was determined from digital subtraction arteriography (DSA) irrespective of the vessel treated. All patients treated had multivisceral occlusive disease and were first-time procedures.

Arteriographic access was obtained through either a transfemoral (29.9%) or transbrachial approach (70.1%). After wire and sheath placement, a flush aortogram was taken, followed by systemic heparinization. Selective visceral vessel cannulation was usually obtained with a reversed curve or angled catheter, and each mesenteric outflow bed was evaluated for collateral circulation and distal disease. For stenotic vessels, the lesion was usually crossed with a 0.035-in glide wire after placement of a 5F or 6F sheath near the lesion.

Once the lesion was crossed, it was predilated if necessary, followed by placement of a premounted balloon-expandable stent or a self-expandable stent. Totally occluded vessels were usually recanalized with a 0.035-in floppy glide wire and a multipurpose or angled glide catheter. If this was not possible, then a long sheath or guide catheter was placed next to the occluded vessel for additional support. The vessels were then recanalized by direct wire passage or subintimal recanalization, and angiographic confirmation was done to assure the wire re-entered a patent distal lumen. Predilatation and stenting were accomplished as described. All stents placed were oversized by approximately 10%. Balloon expandable stents were placed for orifice lesions, and self-expanding stents were placed for nonorifice lesions in areas of curves. All patients received aspirin and clopidogrel postoperatively.

Postoperative treatment follow-up included a history, physical examination, and DUS imaging at 1 month, 3 months, and every 6 months thereafter. All patients' clinical symptoms and weight gain were recorded at each visit. If symptoms returned or DUS imaging suggested restenosis >60%, patients underwent repeat diagnostic angiograms.

Statistical analysis. Patient demographics analyzed included age, sex, preoperative symptoms, history of previous vascular surgery, coronary artery disease (CAD), hypertension, congestive heart failure (CHF), chronic obstructive pulmonary disease (COPD), history of stroke, renal failure, diabetes mellitus, and history of tobacco use. Procedural details analyzed included the specific vessel treated, number of vessels treated, number of stents placed per vessel, type of stent used, and access location. The outcome measures analyzed were cumulative primary, primary assisted, and secondary patency, and death. Patencies were determined by Society for Vascular Surgery guidelines.[11] Arteriograms and operative notes were reviewed for stent characteristics, and degree of stenosis was categorized as severely stenotic or occluded.

To assess the relationship between time to patency loss or death and other risk factors, univariable and multivariable time-to-event models were fit. Kaplan-Meier methods were used to perform univariable comparisons, and statistical significance was based on the log-rank. For multivariable evaluations, the P values are from Wald tests in Cox regression models (testing whether the hazards are similar), except where noted, when Score tests provided more reliable estimates when undefined risk estimates existed.

Because many patients may have more than one vessel treated and more than one stent placed, marginal Cox proportional hazards models were used to correct for the correlation within a patient on patency, and traditional Cox proportional hazards models were used to evaluate mortality, which had one observation per patient. A stepwise model was used to select the variables in the multivariable model, from a pool of variables that had a univariable value of $P \leq .20$.

The generalized estimating equation logistic regression model and the Fisher exact test were used to evaluate whether the certain preoperative and perioperative measures were associated with whether vessels were occluded or stenotic. Odds ratios (OR) and 95% confidence intervals (CI) were estimated to compare risk levels between groups. Analysis of patency was performed at a per-stent level, and analysis of mortality was performed by patient. In the mortality analysis, factors that differed by stent were summed or averaged to allow one measurement per pa-

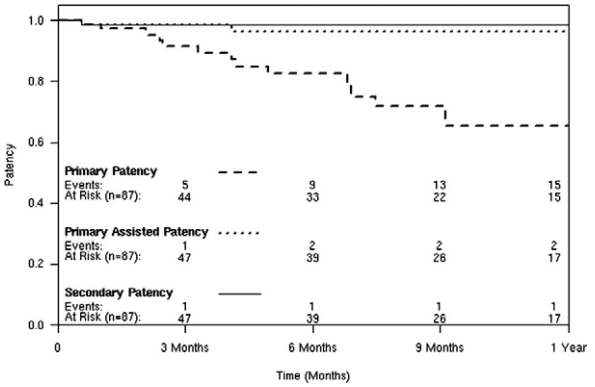

Fig 1. Kaplan-Meier cumulative 1-year rates for primary, primary-assisted, and secondary patency.

tient. A significance level of $P = .05$ was assumed for all comparisons. Analyses were performed using SAS software (SAS Institute, Cary, NC), and plots were created using R software.[12]

RESULTS

Sixty-five patients (29 men, 36 women) had 87 mesenteric vessels treated (average, 1.34 vessels per patient). The mean age was 70 years (range, 44-89 years). The specific vessels treated were 57 superior mesenteric arteries (SMA; 65.5%), 23 celiac arteries (CA; 26.4%), and seven inferior mesenteric arteries (IMA; 8.1%). In 22 patients, the following combinations of two vessels were treated: SMA and CA, 19; SMA and IMA, two; and IMA and CA, one. No patient had more than two vessels treated. Completely occluded vessels were treated in 18 patients (28%), and >60% stenosis was treated in 47 patients (72%).

Balloon-expandable stents were placed in 80 vessels (91.5%), and self-expandable stents were placed in seven (8.5%). Several patients had more than one stent placed per vessel for a total 137 stents placed in 87 vessels. In 12 patients, two stents were placed in a single vessel, three stents were placed in one patient, and four stents were placed in 1 patient. The mean ± SD diameter of stents placed was 6.5 ± 2.2 mm, and the average length was 18.8 ± 6.4 mm; for two patients (3 vessels), information on the stent length or diameter used was not available. Of the four isolated IMA stents placed, three of the patients had occluded celiac and superior mesenteric arteries that could not technically be recanalized, and one patient had an incomplete marginal arcade with a stenotic IMA and ischemic colitis.

Outcomes. Symptom relief was immediate in 85% of the patients, and 75% of patients had symptom relief beyond 1 year. The overall morbidity rate was 30.8%. The most common complication was access site hematoma/pseudoaneurysm/thrombosis (15.4%), followed by bowel infarction (4.6%). All deaths occurred ≤60 days after treatment. The in-hospital/30-day mortality rate was 7.7%. Three of the five in-hospital/30-day deaths were due to postintervention bowel ischemia requiring resection; all of these patients died from sepsis and multisystem organ failure. One patient died from pneumonia on postoperative day 17, and one died from a stroke on postoperative day 26. In the other patient who underwent bowel resection, toxic mega-colon from *Clostridium difficile* colitis developed 6 weeks postoperatively.

The cumulative 1-year patency rates (Fig 1) were primary patency, 65% (95% CI, 50%-80%); primary assisted patency, 97% (95% CI, 92%-100%); and secondary patency, 99% (95% CI, 96%-100%). All primary patency losses occurred ≤9 months of therapy, and all patients were treated by reintervention with balloon angioplasty or stenting, or both. Three of the patients who underwent reintervention required an additional stent, and two patients required two additional stents. In the patient who had a completely occluded stent, recurrent symptoms developed and stent recanalization was done without the use of thrombolytics.

Univariable comparisons of preoperative risk factors are listed in Table II. For preoperative risk factors, those patients who had hypertension, COPD, and bowel dysfunction all had significantly diminished patency rates. Complications and operative risk factors associated with primary patency are listed in Tables III, *A* (online only), III, *B*, and III, *C* (online only). No specific complication was associated with diminished patency, but for operative parameters, those who had femoral access were more likely to lose primary patency (78.2% [95% CI, 63.6%-92.9% vs 43.5%, 95% CI, 16.4%-70.6%]; $P = .03$). There was no difference in patency rate irrespective of vessel treated (CA, SMA, IMA), stent type, number of stents placed, size of stent placed, diameter and length of stent placed, or number of vessels treated in each patient. Multivariable regression analysis demonstrated the presence of bowel dysfunction (hazard ratio [HR] 10.8; 95% CI, 1.7-70.3; $P = .013$) or femoral access (HR, 4.6; 95% CI, 1.6-13.8; $P = .006$) had increased risk of primary patency loss.

The cumulative 1-year survival rate was 89% (95% CI, 80%-98%; Fig 2). All deaths occurred ≤60 days of treatment. There was no difference in patency, complication, or survival rate irrespective of vessel treated (CA, SMA, IMA), stent type, number of stents placed, size of stent placed, diameter and length of stent placed, or number of vessels treated in each patient. For preoperative risk factors, those patients who had hypercholesterolemia had >1-year survival rates of 100.0% (95% CI, 100.0%-100.0%) vs 81.6% (95% CI, 66.8%-96.4%; $P = .05$), and there was a trend towards decreased survival in those who had COPD of 94.4% (95% CI, 86.8%-100.0%) vs 74.7% (95% CI, 49.4%-99.9%; $P = .09$). No patient who underwent bowel resection after the procedure survived ($P = .001$). Femoral artery access as opposed to brachial artery access was the only operative risk factor that trended towards decreased survival (83.7% [95% CI, 70.4%-97.0%] vs 100.0% [95% CI, 100.0%-100.0%]; $P = .09$). Multivariable modeling was not performed owing to the low incidence of death in the cohort.

Table II. Comparison of primary patency rates/stent and preoperative risk factors

Factor	*Group*	*N*	*12 months, % (range)*	*HR (95% CI)*	*Reference*
Sex	Male	36	66.3 (43.4-89.2)	1.0	.86
	Female	51	63.6 (43.3-83.8)	1.09 (0.41-2.90)	
Smoking	No	17	66.3 (33.8-98.9)	1.0	.97
	Yes	70	65.3 (48.7-81.9)	0.97 (0.25-3.78)	
Hypertension	No	7	100.0 (100.0-100.0)	1.0	.03
	Yes	80	62.8 (47.1-78.5)	2.20 (1.09-4.46)	
CAD	No	24	65.5 (32.8-98.1)	1.0	.42
	Yes	63	65.4 (49.0-81.8)	1.51 (0.55-4.18)	
COPD	No	65	71.4 (54.8-88.1)	1.0	.008
	Yes	22	45.7 (14.8-76.6)	3.23 (1.36-7.67)	
Renal disease	No	68	67.4 (50.8-83.9)	1.0	.069
	Yes	19	62.9 (33.6-92.1)	2.26 (0.94-5.45)	
Hypercholesterolemia	No	48	64.9 (43.9-86.0)	1.0	.74
	Yes	39	64.0 (41.4-86.6)	0.85 (0.33-2.20)	
Diabetes	No	72	68.6 (51.6-85.6)	1.0	.26
	Yes	15	59.3 (31.3-87.4)	1.96 (0.61-6.29)	
Pain	No	3	0.00 (0.00-0.00)	1.0	.24
	Yes	84	66.9 (51.9-81.8)	0.45 (0.12-1.68)	
Weight Loss	No	29	64.5 (41.2-87.8)	1.0	.76
	Yes	58	67.3 (48.8-85.7)	0.86 (0.32-2.29)	
Diarrhea	No	64	57.2 (37.9-76.4)	1.0	.11
	Yes	23	85.0 (65.0-100.0)	0.26 (0.05-1.36)	
Bowel dysfunction	No	77	69.4 (54.3-84.6)	1.0	.032
	Yes	10	0.00 (0.00-0.00)	4.61 (1.14-18.53)	
GI bleeding	No	79	62.1 (46.1-78.1)	1.0	.15[a]
	Yes	8	100.0 (100.0-100.0)	NA	
Previous vascular surgery	No	74	67.9 (52.2-83.5)	1.0	.31
	Yes	13	. (0.00)	1.71 (0.61-4.84)	

CAD, Coronary artery disease; *CI,* confidence interval; *COPD,* chronic obstructive pulmonary disease; *GI,* gastrointestinal; *HR,* hazard ratio.
[a]Score test.

Table III, *B.* Comparison of associations between vessel occlusion and complications

			Occluded		*Stenotic*			
Risk factor	*Level*	*Total*	*No.*	*%*	*No.*	*%*	*OR (95% CI)*	P[a]
Hematoma	No	81	21	25.9	60	74.1	1.0	.33F
	Yes	6	0	0.00	6	100.0	NA	
GI bleeding	No	84	18	21.4	66	78.6	1.0	.013F
	Yes	3	3	100.0	0	0.00	NA	
False aneurysm	No	83	18	21.7	65	78.3	1.0	.016
	Yes	4	3	75.0	1	25.0	10.69 (1.55-73.70)	
Bowel resection	No	83	19	22.9	64	77.1	1.0	.47
	Yes	4	2	50.0	2	50.0	2.46 (0.21-28.79)	
Diarrhea	No	84	21	25.0	63	75.0	1.0	.99F
	Yes	3	0	0.00	3	100.0	NA	

CI, Confidence interval; *GI,* gastrointestinal; *NA,* not applicable; *OR,* odds ratio.
[a]*P* values are from generalized estimating equation logistic regression, except where marked by an *F*, where the Fisher exact test was used.

Kaplan-Meier cumulative 1-year patency rates comparing stenotic and completely occluded vessels are demonstrated in Fig 3. There was an initially greater loss of primary patency in totally occluded vessels compared with stenotic vessels; however, by 1 year the Kaplan-Meier cumulative primary patency rates were equal at 63% (95% CI, 45%-81%) vs 70% (95% CI, 43%-96%; $P = .68$). Risk factor comparison between stenotic and occluded vessels is demonstrated in Tables III, *A* (online only), III, *B*, and III, *C* (online only). The following risk factors had statistically different incidences in stenotic compared with occluded vessels: COPD, postoperative gastrointestinal hemorrhage, and postoperative pseudoaneurysm formation. However, these differences between groups did not impact the multivariable patency and survival results. Also, there was no difference in 1-year cumulative survival rates (Fig 2) between completely occluded and partially occluded vessels (91% [95% CI, 82%-100%] vs 84% [95% CI, 62%-100%]; $P = .43$).

DISCUSSION

The first description of treating mesenteric vessels by percutaneous angioplasty was in 1980 by Furrer et al.[13] We

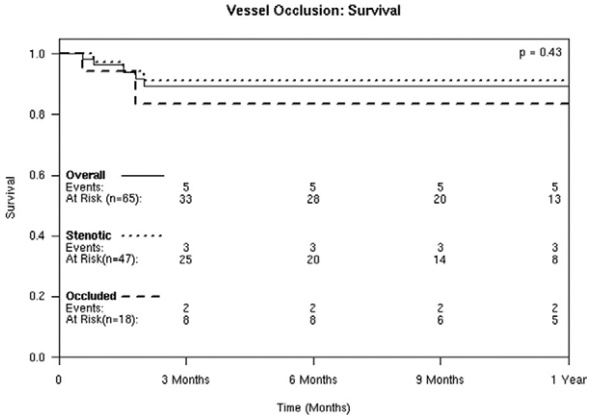

Fig 2. Kaplan-Meier cumulative 1-year survival for all groups for vessel occlusion.

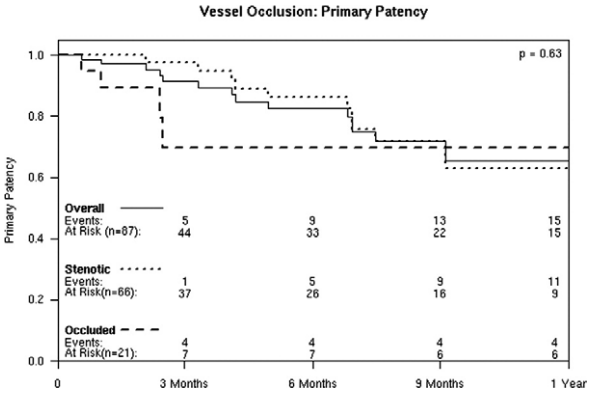

Fig 3. Kaplan-Meier cumulative 1-year primary patency for stenotic vs occluded vessels.

previously described a series of five patients who successfully were treated by recanalizing chronically occluded visceral vessels with PTAS for CMI.[14] Since these publications, numerous studies have documented the success of PTAS for CMI.[15-17] The purpose of this study was to extend these data by looking at midterm and 1-year outcomes to compare the results of PTAS of completely occluded vessels with those in severely stenotic vessels, and to evaluate predictors of patency.

Our primary patency rate of 69% was less than expected but similar to other contemporary series that reported restenosis rates of 20% at 6 months[1] and 53% at 1 year.[8] The reasons for a high reintervention rate can be multifactorial. One possible explanation is this disease process is an extension of aortic atherosclerosis and there is a large degree of plaque burden. It is possible that stent grafts may offer a better solution, but to date, no stent has been approved for this location, let alone stent graft, and trials will need to be conducted. Current concerns over the routine use of stent grafts for visceral occlusive intervention include the need for larger access sheaths, decreased size availabilities, concern over collateral/branch coverage, and increased restenosis rates.

Although several risk factors, such as hypertension, COPD, constipation, and femoral access, were associated with decreased primary patency rates, multifactorial analysis found that bowel function and femoral access were the most significant risk factors to predict decreased patency. The decreased patency from femoral access possibly relates to technical details of an antegrade vs retrograde access for treatment. In general, we have adapted an antegrade approach from brachial access as the preferred method of access. From a brachial approach, the trajectory for catheter manipulation is simplified. Furthermore, the angles in a severely down-sloping visceral artery can preclude precise stent placement from a femoral approach.

There was no difference in complication rates from access sites, although this may be a reflection of the small number. The association of decreased patency and bowel dysfunction may be related to diminished oral intake from recurrent symptoms, ischemic damage to the myenteric plexi, or possibly persistent bowel dysfunction in those patients who had undetected microembolization.

A major objective of this study was to demonstrate that recanalization PTAS of totally occluded visceral vessels is not only technically feasible but also has satisfactory outcome data. Cumulative patency rates found that there were similar primary patency rates of both stenotic and occluded vessels in addition to survival. Nevertheless, given that the in-hospital or 30-day mortality rate was 7.7% and three patients required bowel resection for segmental infarction, embolic protection may potentially prevent this complication in both stenotic and occluded vessels.

We also evaluated several different types and lengths of stents used in this study. Most of the stents used were balloon-expandable stents, which indicates that most of the disease was an extension of surrounding aortic atherosclerosis. Self-expanding stents were usually reserved for tortuous vessels beyond the orifice. There was no difference in patency rates irrespective of stent type, size, or number and no difference in patency rates between any of the vessels treated (CA, SMA, and IMA). Finally, intervening on more than one vessel and placing more than one stent in a vessel also did not contribute to diminished patency. There has been some debate about whether more than one vessel should be revascularized[18,19] in open mesenteric bypass patients. Although anecdotal, given the diminished primary patency rates, we recommend PTAS of all stenotic vessels if technically feasible.

The in-hospital or 30-day mortality rate was 7.7%, and the 1-year cumulative survival rate was 89%. These results compare favorably with other contemporary series of open and percutaneous treatment of CMI.[1,7,8,20,21] All patients who died had patent stents at the time of their death. Three of the five in-hospital deaths occurred in patients who ended up with bowel resections, and these patients were 26 times more likely to die. It is possible that in the patients who required bowel resection, embolization developed as a result of the intervention; however,

pathologic evaluation of the specimens failed to detect emboli. Nevertheless, the segmental nature of the infarction cannot exclude microembolism as an etiologic factor. Another possible explanation is that the patients were not properly diagnosed with an advanced degree of ischemia that progressed to an acute on chronically ischemic scenario; perhaps these patients would have been better off undergoing abdominal exploration and open surgical revascularization.

No one specific risk factor was associated with a higher incidence of death other than the complication of bowel infarction, and this included patients who had treatment of a complete occlusion. Patients who had hypercholesterolemia appeared to have a survival advantage, and this may have been related to these patients receiving aggressive medical intervention with statins. The small number of deaths made multifactorial analysis inconclusive. We did not measure statin use in this study, but it would be interesting to see if this also led to an advantage or protective affect from restenosis.

This study does have several limitations. It is retrospective in nature, and the small number of events may have limited the ability to detect important predictive factors. Further, the large number of stents used made evaluation of this factor less meaningful. Nevertheless, to our knowledge it is the largest series to date documenting the usefulness of PTAS for chronic mesenteric occlusive disease and includes a cohort of patients (totally occluded visceral arteries) who were previously thought to be unacceptable candidates for this therapy. This is also important given that many of these patients have serious medical comorbidities, including >70% with significant coronary artery disease. Finally, there are no widely established DUS criteria for accepting "in-stent" restenosis, possibly missing some restenotic lesions. In this study, however, the arteriographic DUS findings were consistent with the DUS findings.

CONCLUSION

Endovascular treatment of completely occluded mesenteric arteries has similar patency and survival rates as those treated for stenotic vessels and can be considered a first-line therapy. High restenosis rates for all mesenteric interventions, and our results presented here, suggest brachial access is superior to femoral access. In addition, newer therapies such as drug-coated stents and newer stent grafts should be evaluated to improve on the high restenosis rates. Finally, embolization is a potential problem that can lead to bowel infarction, and embolic protection should be considered.

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AUTHOR CONTRIBUTIONS

Conception and design: TS, OA, VK, SL, SS, ME, DC
Analysis and interpretation: TS, OA, JB, VK, SL, SS, ME, DC
Data collection: TS, OA
Writing the article: TS, OA, JB, VK
Critical revision of the article: TS, VK, SL, SS, ME
Final approval of the article: TS, OA, JB, VK, SL, SS, ME, DC
Statistical analysis: TS, OA, JB
Obtained funding: TS, DC
Overall responsibility: TS, OA

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Table I (online only). Patient demographics

Variable	*No.*	*%*
Risk factors		
Hypertension	59	90.8
Tobacco	51	78.5
Coronary artery disease	46	70.7
Hypercholesterolemia	28	43.8
COPD	16	24.6
Previous vascular surgery	13	20.0
Renal insufficiency	12	18.5
Diabetes mellitus	9	13.8
Symptoms		
Intestinal angina	62	95.4
Weight loss	44	67.7
Diarrhea	17	26.2
Hematochezia/melena	5	7.7

COPD, Chronic obstructive pulmonary disease.

Table III, *A* (online only). Comparison of associations between vessel occlusion and preop risk factors

			Occluded		*Stenotic*			
Risk factor	*Level*	*Total*	*No.*	*%*	*No.*	*%*	*OR (95% CI)*	P[a]
Gender	Male	36	8	22.2	28	77.8	1.0	.52
	Female	51	13	25.5	38	74.5	1.42 (0.48-4.19)	
Smoking	No	17	4	23.5	13	76.5	1.0	.87
	Yes	70	17	24.3	53	75.7	1.12 (0.27-4.63)	
Hypertension	No	7	1	14.3	6	85.7	1.0	.61
	Yes	80	20	25.0	60	75.0	1.78 (0.19-16.41)	
CAD	No	24	6	25.0	18	75.0	1.0	.83
	Yes	63	15	23.8	48	76.2	0.88 (0.26-2.92)	
COPD	No	65	12	18.5	53	81.5	1.0	.034
	Yes	22	9	40.9	13	59.1	3.42 (1.10-10.67)	
Renal Disease	No	68	18	26.5	50	73.5	1.0	.53
	Yes	19	3	15.8	16	84.2	0.64 (0.16-2.57)	
Hypercholesterolemia	No	48	14	29.2	34	70.8	1.0	.36
	Yes	39	7	18.0	32	82.1	0.59 (0.19-1.82)	
Diabetes mellitus	No	72	18	25.0	54	75.0	1.0	.64
	Yes	15	3	20.0	12	80.0	0.67 (0.13-3.54)	
Pain	No	3	0	0.00	3	100.0	1.0	.99F
	Yes	84	21	25.0	63	75.0	NA	
Discomfort	No	58	13	22.4	45	77.6	1.0	.42
	Yes	29	8	27.6	21	72.4	1.56 (0.53-4.59)	
Weight loss	No	29	7	24.1	22	75.9	1.0	.86
	Yes	58	14	24.1	44	75.9	0.90 (0.29-2.82)	
Diarrhea	No	64	13	20.3	51	79.7	1.0	.26
	Yes	23	8	34.8	15	65.2	1.97 (0.61-6.33)	
Bowel dysfunction	No	77	21	27.3	56	72.7	1.0	.11F
	Yes	10	0	0.00	10	100.0	NA	
GI bleeding	No	79	20	25.3	59	74.7	1.00 (1.00-1.00)	.34
	Yes	8	1	12.5	7	87.5	0.38 (0.05-2.80)	
Previous vascular surgery	No	74	19	25.7	55	74.3	1.0	.54
	Yes	13	2	15.4	11	84.6	0.60 (0.12-3.08)	

CAD, Coronary artery disease; *CI,* confidence interval; *COPD,* chronic obstructive pulmonary disease; *GI,* gastrointestinal; *NA,* not applicable; *OR,* odds ratio.
[a] *P* values are from generalized estimating equation logistic regression, except where marked by an *F*, where the Fisher exact test was used.

Table III, *C* (online only). Comparison of associations between vessel occlusion and operative details

			Occluded		*Stenotic*			
Risk factor	*Level*	*Total*	*No.*	*%*	*No.*	*%*	*OR (95% CI)*	P[a]
SMA	No	29	6	20.7	23	79.3	1.0	.59
	Yes	58	15	25.9	43	74.1	1.28 (0.52-3.14)	
IMA	No	80	21	26.3	59	73.8	1.0	.19F
	Yes	7	0	0.00	7	100.0	NA	
Celiac artery	No	64	15	23.4	49	76.6	1.0	0.77
	Yes	23	6	26.1	17	73.9	1.16 (0.44-3.05)	
>1 stent used	No	71	17	23.9	54	76.1	1.0	0.72
	Yes	14	4	28.6	10	71.4	0.70 (0.11-4.66)	
Mean stent diameter, mm	<6	19	5	26.3	14	73.7	1.0	
	6-6.99	33	8	24.2	25	75.8	0.70 (0.17-2.95)	.63
	≥7	32	8	25.0	24	75.0	1.00 (0.31-3.25)	.99
Mean stent length, mm	<18	28	7	25.0	21	75.0	1.0	.60
	18-19.99	27	5	18.5	22	81.5	0.70 (0.22-2.21)	.54
	≥20	30	9	30.0	21	70.0	1.49 (0.45-4.86)	.51
Interventions, No.	1	64	17	26.6	47	73.4	1.0	.64
	2	15	2	13.3	13	86.7	0.47 (0.10-2.35)	.36
	3	8	2	25.0	6	75.0	1.08 (0.20-5.88)	.93
Brachial access	No	17	1	5.9	16	94.1	1.0	.086
	Yes	70	20	28.6	50	71.4	6.32 (0.77-51.76)	
Femoral access	No	61	18	29.5	43	70.5	1.0	.082
	Yes	26	3	11.5	23	88.5	0.30 (0.08-1.16)	

CI, confidence interval; *IMA,* inferior mesenteric artery; *OR,* odds ratio; *SMA,* superior mesenteric artery.
[a] *P* values are from generalized estimating equation logistic regression, except where marked by an *F*, where the Fisher exact test was used.